GEK-104145

TECHNICAL MANUAL
FOR

FIRE PUMP AC MOTOR CONTROLLER SIZE FIVE REDUCED–VOLTAGE AUTOTRANSFORMER TYPE

GENERAL ELECTRIC COMPANY
CONTRACT NUMBER N00406-93-M-N290

MARCH 1994

FOREWORD

This manual provides installation, operating, and maintenance instructions for GE's IC5130 size five, reduced-voltage, autotransformer ac motor controllers for fire pump application onboard ship. This manual consists of the following sections:

This manual was prepared under commercial specifications for contract N00406-93-M-N290. The contents meet the requirements of Technical Manual Contract Requirement (TMCR) No. NDMS-930068-000.

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SAFETY SUMMARY

GENERAL PRECAUTIONS

The following are general safety precautions not related to any specific procedure, so they do not appear elsewhere in this manual. These are recommended precautions that personnel must fully understand and apply during all phases of operation and maintenance of the equipment.

Keep Away From Live Circuits. Personnel must at all times observe all safety regulations. It is crucial that all power supplies be turned off before replacing components or making adjustments inside the equipment. Note that dangerous conditions may still exist when the power is in the "off" position, because capacitors sometimes retain charges. To avoid casualties when working on the equipment, always remove power, then discharge and ground a circuit before touching it.

WARNING

High voltages capable of causing death are used in this equipment. Use extreme caution when servicing either the power supplies or their switching components.

Do Not Service or Adjust When Alone. Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment, unless another person capable of rendering aid is present.

Resuscitation. Personnel working with or near high voltages should know and be able to apply approved methods of resuscitation. Such information can be obtained from the Bureau of Medicine and Surgery.

SPECIFIC PRECAUTIONS

The precautions listed below are also located in the text of this manual to alert and guide personnel when a specific procedure or instruction contains a potential danger to them or to the equipment. These precautions precede the specific procedure or instruction.

WARNING

Disconnect all power supplies before performing any maintenance, adjustments, servicing, parts replacements, or other act requiring physical contact with the electrical working components or wiring of this equipment. (Pages 4-1 and 6-1)

WARNING

Use only one hand when servicing live equipment. This prevents an accidental current path being created through the body from one hand to the other. (Page 4-1)

WARNING

Before any maintenance, adjustments, servicing, parts replacements, or other act is performed requiring physical contact with the electrical working components or wiring of this equipment, disconnect all power supplies, then discharge and ground the equipment. (Page 5-1)

WARNING

Before handling and connecting any power cables to the equipment, ensure that all power supplies are turned off. Then check voltage levels on the wiring to ensure that the wiring is not carrying hazardous voltages. (Page 8-3)

CAUTION

Short out all meter terminals and disconnect diodes and other electronic components that might be damaged by application of insulation resistance measuring voltage before performing the insulation resistance test. (Page 4-4)

CAUTION

Do not under any circumstances manually trip a relay by forcing the trip mechanism. This will deform the mechanism, permanently disturbing calibration. (Page 6-1)

CAUTION

To avoid damaging the timing relay needle or orifice, turn the adjusting screw only a fraction of a revolution before each timing check. (Page 6-1)

CAUTION

Before moving equipment, ensure that the doors are closed and their thumb screws are fastened. (Page 8-1)

CAUTION

Remove all cartons and other miscellaneous material packed inside units before energizing any heaters. (Page 8-3)

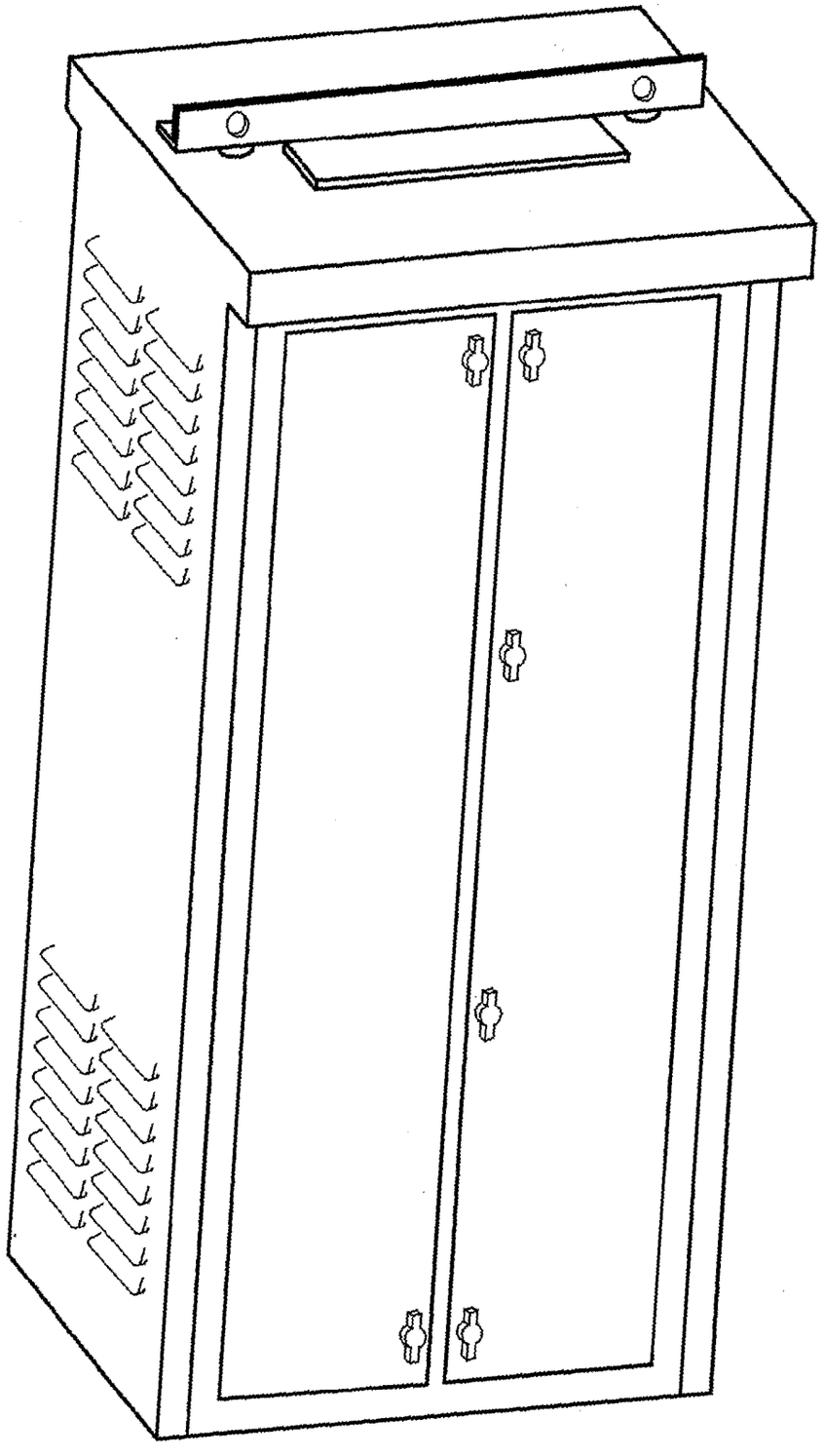

Figure 1-1. Typical Controller

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CHAPTER 1

SAFETY PRECAUTIONS AND GENERAL INFORMATION

1-1. SAFETY PRECAUTIONS

Ac motor controllers use hazardous voltages. This manual includes warning and caution statements that must be observed to ensure the safety of personnel and equipment. It is important to fully understand the warnings, cautions, and instructions in this manual before operating or maintaining this equipment.

1-1.1. Warning Statements

A warning statement alerts personnel to a step of a procedure that, if not strictly followed, could seriously injure or kill someone.

1-1.2. Caution Statements

A caution statement alerts personnel to a step of a procedure that, if not strictly followed, could damage or destroy equipment.

1-1.3. Safety Summary

For a listing of all warnings and caution statements used in this manual, refer to the Safety Summary located in the front matter.

1-2. INTRODUCTION

This manual provides installation, operating, and maintenance instructions for GE's IC5130B38 ac motor controllers. This equipment consists of 16 size 5 magnetic type controllers, as shown in Figure 1-1.

1-3. EQUIPMENT DESCRIPTION

1-3.1. Identification

The motor controller configuration is identified by GE catalog (part) number 229B3195G1S2. This part number is located on the controller nameplate, and is used to identify the controller when ordering replacement parts.

The first section of the part number, 229B3195, identifies the basic controller and is also the engineering drawing number. The G1 digits indicate the group number from the material list (on the engineering drawing), representing material variations in the equipment. The S2 digits indicate the engineering drawing sheet number (sheet 2) that contains the connection diagram. (Engineering drawings are not included in this manual.)

1-3.2. Equipment Specifications

The equipment meets the requirements of Military Specification MIL-C-2212F for ac motor controllers for Naval Shipboard use, with the exception of AMP wire terminals and current transformers 1CT and 2CT. The AMP wire terminals are approved by NAVSEA Letter Ser. 05J/144 dated 6/8/93. Current transformers 1CT and 2CT are approved by NAVSEA Letter Ser. 05E2/296 dated 6/24/93.

The controller units have the following specifications:

Certification data drawing: 305A3195

Size: 5

Input power rating: 440 V, 3-phase, 60 Hz

Duty: Continuous

Type: Reduced voltage (autotransformer), single speed, non-reversing

Control: Local and remote

Motor rating: 200 hp maximum, 270 A maximum

Ambient temperature: 50 °C (122 °F)

Weight: 1260 lbs calculated, unboxed

Enclosure: Dripproof

1-3.3. Equipment Application

The controllers are designed for shipboard applications with squirrel-cage induction motors for fire pumps.

CHAPTER 2

OPERATION

2-1. INTRODUCTION

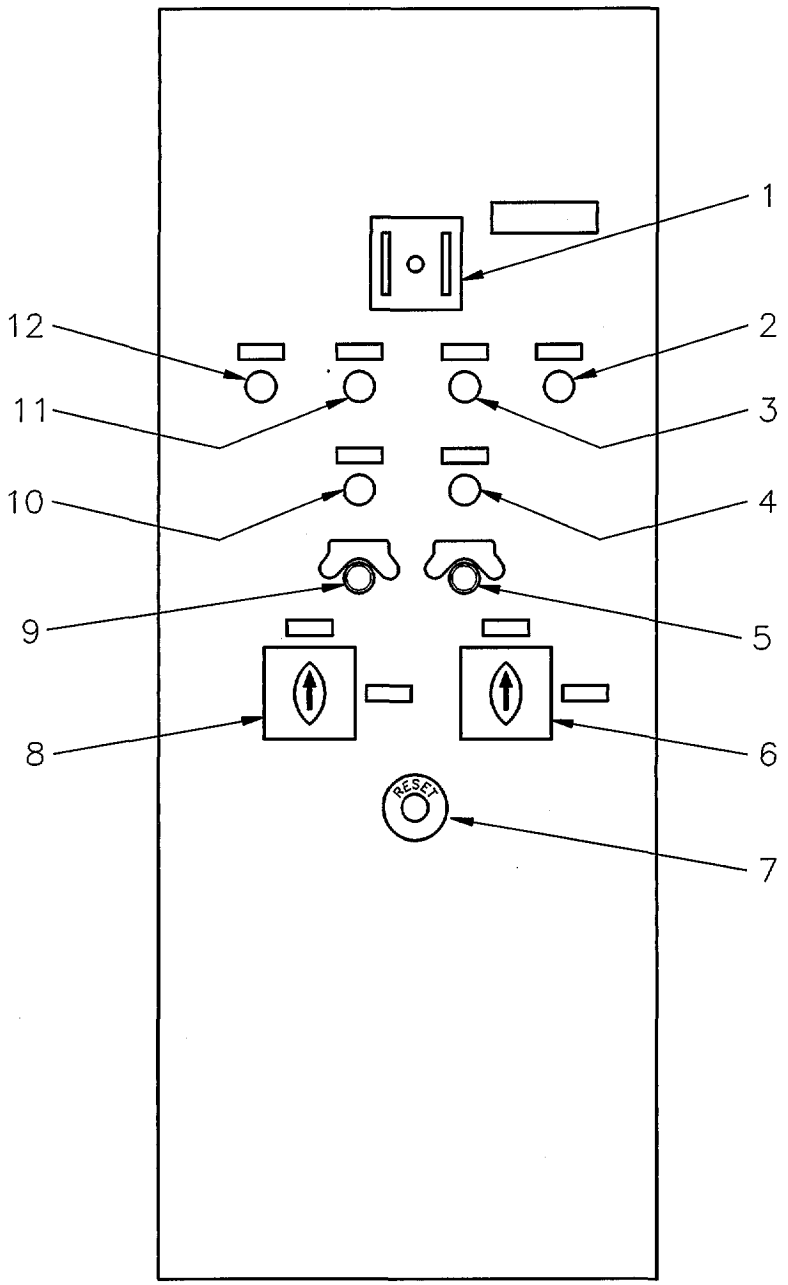
Figure 2-1 shows the front panel of the controller (left-hand door), and identifies each of the operator devices. These devices include controls, such as pushbuttons and switches, and indicator lamps. Table 2-1 lists and defines each of these operator devices.

2-2. OPERATING PROCEDURES

The controller can be operated in local or remote modes. Local mode allows the operator to control the motor using the START and STOP pushbuttons on the controller front panel. Remote mode allows the operator to start and stop the motor from devices not mounted on the controller. Table 2-2 lists operating procedures for both modes of operation.

Table 2-1. Operating Controls and Indicators

Figure and Item Number	Item Name	Item Description
2-1, 12	POWER AVAILABLE light (white)	Power available to controller when on.
2-1, 11	PUMP READY light (white)	Pump ready for operation when on.
2-1, 3	MONITOR POWER AVAILABLE light (white)	Power available to monitor when on.
2-1, 2	MONITOR TRIPPED light (red)	Normal operation stopped when on.
2-1, 10	MOTOR RUNNING light (green)	Motor running when on.
2-1, 4	BATTLE OVERRIDE light (yellow)	Controller in Battle Override mode when on.
2-1, 9	START pushbutton	In local operating mode, pressing pushbutton starts motor.
2-1, 5	STOP pushbutton	In local operating mode, pressing pushbutton stops motor.
2-1, 8	LOCAL/REMOTE control switch	REMOTE position to select the remote operating mode. LOCAL position to select the local operating mode.
2-1, 6	BATTLE OVERRIDE/ NORMAL control switch	NORMAL position to run the motor under normal conditions. BATTLE OVERRIDE position to run the motor without overload, overheating, or interlock protection.
2-1, 7	RESET/EMERGENCY RUN pushbutton	Pressing pushbutton resets controller; holding pushbutton in enables motor to run in an overload condition



1 Fuse (1FU, 2FU)
2 MONITOR TRIPPED light
3 MONITOR POWER AVAILABLE light
4 BATTLE OVERRIDE light
5 STOP pushbutton
6 NORMAL/BATTLE OVERRIDE control switch
7 RESET/EMERGENCY RUN pushbutton
8 LOCAL/REMOTE control switch
9 START pushbutton
10 MOTOR RUNNING light
11 PUMP READY light
12 POWER AVAILABLE light

Figure 2-1. Operator Panel Controls and Indicators

Table 2-2. Operating Procedures

Operating Mode	Function	Procedures
Local	Select the local operating mode.	1. Turn the LOCAL/REMOTE control switch to the LOCAL position.
	Initial motor start.	1. Ensure that the NORMAL/BATTLE OVERRIDE control switch is in the NORMAL position (BATTLE OVERRIDE light is off). 2. Ensure that the remote SEA CHEST, SUCTION, and DISCHARGE valves are open. 3. Press the local START pushbutton.
	Stop motor.	1. Press the local STOP pushbutton.
	Emergency motor start.	1. Turn the NORMAL/BATTLE OVERRIDE control switch to the BATTLE OVERRIDE position.
	Emergency run without overload protection.	1. Press and hold the local RESET/EMERGENCY RUN pushbutton. 2. Press the local START pushbutton.
	Emergency run without overload, motor temperature, or interlock protection.	1. Turn the NORMAL/BATTLE OVERRIDE control switch to the BATTLE OVERRIDE position.
Remote	Select the remote operating mode.	1. Turn the LOCAL/REMOTE control switch to the REMOTE position.
	Initial motor start.	1. Ensure that the NORMAL/BATTLE OVERRIDE control switch is in the NORMAL position (BATTLE OVERRIDE light is off). 2. Ensure that the remote SEA CHEST, SUCTION, and DISCHARGE valves are open. 3. Press a remote START control.
	Stop the motor.	1. Press a remote STOP control.

CHAPTER 3

FUNCTIONAL DESCRIPTION

3-1. INTRODUCTION

An ac motor controller is an electrical device or group of devices that controls the electric power input to an ac motor. The type and extent of control provided depends upon the unit type and configuration of the controller, as determined by the system requirements.

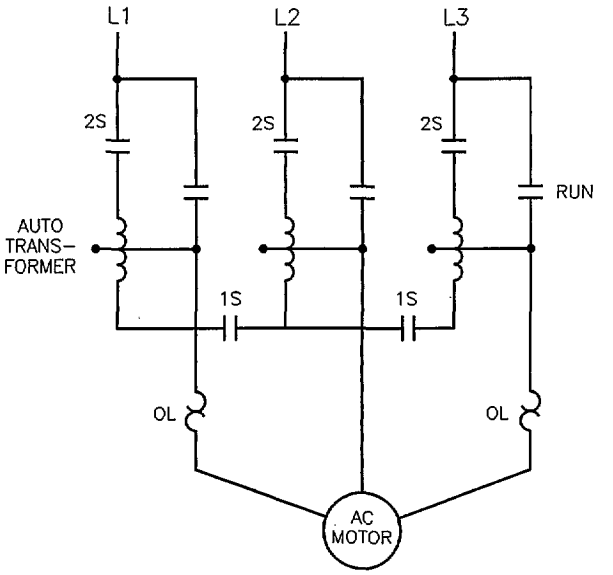
The basic functions of a controller can be line closing and opening, acceleration, retardation, speed changing, reversal, etc. These functions are performed by contactors and/or relays operated by electromagnets. A controller can also contain other devices, such as control power transformers, overload relays, pushbuttons, indicating lights, meters, and terminal boards, as needed.

This chapter discusses ac controller circuitry and provides typical examples. Refer to Chapter 5 for the controller electrical diagrams.

3-2. CONTROLLER SWITCHING CIRCUITS

Controller units perform motor functions, such as starting and stopping, reversing, and speed changing, by closing and opening contactors on the lines that connect the motor to the ac power source. The IC5130B38 controller covered in this manual contains three IC5181 contactors, which are described in section 3-2.1.

The IC5130B38 is a reduced-voltage, non-reversing, single-speed controller. Figure 3-1 shows a simplified motor circuit for this type of controller.



CONTACTOR SEQUENCE

CONTACTOR	START	CLOSED TRANSITION		RUN
		1	2	
1S	X			
2S	X	X	X	
RUN			X	X

Figure 3-1. Reduced-voltage Type Controller Unit

3-2.1. Contactor Operation

The IC5181 contactor is operated by a shunt-coil magnet. The magnet plunger is connected to a lever that brings the movable tip structure forward when the coil is energized, thereby closing the main and auxiliary contacts. The contactor normally contains two auxiliary contact units, one on each side of the contactor. Each auxiliary contact unit has two double-break contacts. Each set of stationary contacts in the auxiliary contact units can be assembled as normally open or normally closed.

3-3. OVERLOAD PROTECTION

Controllers contain overload relays that interrupt the line contactor coil circuit when an overcurrent condition occurs. This causes the line contactors to drop out, disconnecting the motor from the ac power source.

The IC5130B38 controller contains five IC5182 multipole relays and one IC5882 temperature-compensated thermal overload relay. The operation of these relays is described in the following sections.

3-3.1. IC5182 Multipole Relay

The IC5182 multipole relay is operated by a shunt-coil magnet. The magnet plunger is connected to a lever that moves the tip structure forward when the coil is energized, thereby closing the relay contacts.

3-3.2. IC5882 Temperature-compensated Thermal Overload Relay

A temperature-compensated thermal overload relay protects the motor, but cannot be tripped by variations in ambient temperature. The IC5882 relay (see Figure 6-2) consists of one or more expansion tubes and heaters, a set of control contacts, and the necessary linkages and reset mechanisms. To operate, the expansion tube trips a set of contacts in response to temperatures produced by heaters within the tube. The expansion tube is mounted on a frame which expands at approximately the same rate as the tube, thus compensating for ambient temperatures. The relay rating changes only about 3% per 10 °C (50 °F) change in ambient temperature.

3-4. MOTOR STARTING

Ac motor controllers are classified as either across-the-line (full voltage) or reduced-voltage. An across-the-line controller uses full voltage to start the motor.

This controller (part number 229B3195) is a reduced-voltage type with autotransformer. The controller uses an autotransformer to provide reduced voltage to start the motor (other reduced-voltage controllers may use resistors or other devices for this purpose). After starting the motor at a reduced voltage, the controller uses a timing relay to deenergize the wye contactor. This energizes the run contactor, which runs the motor at full voltage.

3-5. LOW-VOLTAGE OPERATION

Controller units are configured for either the Low-voltage Protection (LVP) or Low-voltage Release (LVR) method of operation. The machinery and the system protection and operational requirements determine the method of operation needed.

3-5.1. Low-voltage Protection

Figure 3-2 shows a simplified LVP circuit. Pressing the START pushbutton closes contactor M. A normally open interlock on M establishes a sealing circuit around the START pushbutton, which is then released. Contactor M stays closed. Pressing the STOP pushbutton opens M. If the control voltage L1-L2 falls below a specified level when contactor M is closed, M opens. Contactor M then stays open until the operator presses the START pushbutton, which closes M.

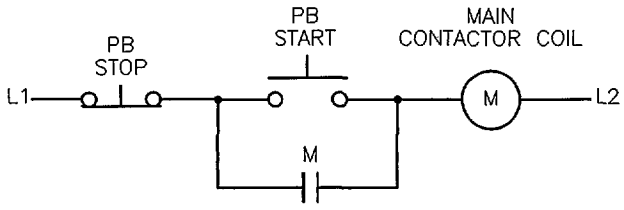


Figure 3-2. Simplified Low-voltage Protection Circuit

3-5.1.1. LOW-VOLTAGE PROTECTION WITH PILOT DEVICE. Figure 3-3 shows an LVP circuit with and added low-voltage relay. A pilot device, such as a limit switch or a pressure switch, can then control the opening and closing of contactor M. In this circuit, a normally open interlock on the LV relay seals around the START pushbutton. When a maintaining-type pilot device is closed, contactor M closes; when the maintaining-type pilot device is opened, contactor M opens. Note, however, that a voltage failure will open relay LV. If this occurs, the operator must press the START pushbutton to set up the circuit for automatic. Relay LV provides the LVP operation in this circuit.

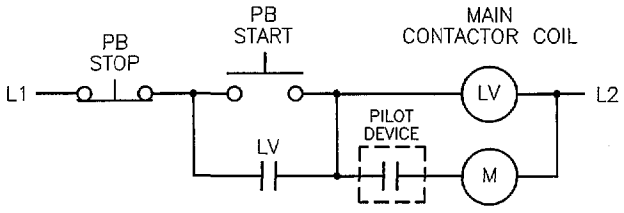


Figure 3-3. LVP Circuit with Pilot Device

3-5.2. Low-voltage Release

Figure 3-4 shows a simplified LVR circuit. If the selector switch enables the LVR operation, contactor M automatically closes when power is applied. If the control voltage falls below a specified level, M opens. When the control voltage returns to a specified level, contactor M automatically closes. To open contactor M and stop the motor, the operator moves the selector switch to the STOP position.

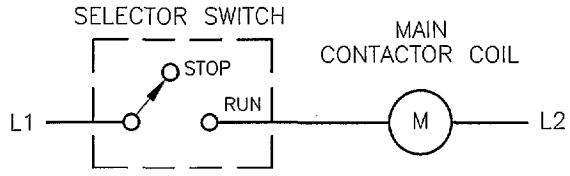


Figure 3-4. Simplified Low-voltage Release Circuit

CHAPTER 4

SCHEDULED MAINTENANCE

4-1. INTRODUCTION

Preventive maintenance consists of inspections, tests, and cleaning of equipment at scheduled intervals. Preventive maintenance helps detect and correct conditions that could cause equipment malfunction.

The scheduled maintenance instructions in this manual are not intended to duplicate those furnished in the Planned Maintenance System (PMS). The procedures in this manual are intended for use where PMS procedures do not exist or do not apply. Shipboard users of this manual will disregard these procedures and will perform maintenance in accordance with the PMS. In case of conflicts, the PMS documentation takes precedence. Such conflicts should be reported immediately on the user comment sheet in accordance with the maintenance procedures for this manual.

4-2. SAFETY PRECAUTIONS

WARNING

Disconnect all power supplies before performing any maintenance, adjustments, servicing, parts replacements, or other act requiring physical contact with the electrical working components or wiring of this equipment.

Ac motor controllers use high voltages (commonly 440 V ac). It is important that only experienced and authorized technicians who observe standard safety precautions perform all phases of installation, operation, and maintenance. Tag the controller OUT OF SERVICE only after it has been fully deenergized.

4-2.1. Servicing Live Equipment

If it is necessary to service live equipment, the following general instructions must be followed:

WARNING

Use only one hand when servicing live equipment. This prevents an accidental current path being created through the body from one hand to the other.

1. Deenergize the equipment. To deenergize any capacitors connected to the terminals to be measured, temporarily ground the terminals.
2. Connect the multimeter to the terminals to be measured, using a range higher than the expected voltage. Ensure that you are not grounded whenever adjusting the equipment or using measuring equipment. Do not use test equipment known to be in poor equipment.
3. Without touching the multimeter or leads, energize the equipment and read the multimeter.
4. Deenergize the equipment before removing the test leads.

4-3. PREVENTIVE MAINTENANCE SCHEDULE

The schedule for conducting preventive maintenance is determined by how often the equipment is used. Table 4-1 lists the suggested maintenance schedule, which is based upon average conditions. This schedule should be adjusted for each application as experience requires.

Table 4-1. Preventive Maintenance Schedule

Frequency of Equipment Operation	Maintenance Interval
Four or more operations per hour	Monthly
Automatic operation	Quarterly
Non-automatic operation (including propulsion systems)	Semi-annually
All others	Annually

4-4. REQUIRED TOOLS AND TEST EQUIPMENT

Table 4-2 lists the tools and test equipment required for the preventive maintenance procedures in this chapter.

Table 4-2. Required Maintenance Tools, Materials, and Test Equipment

Tools

1. Flashlight
2. Vacuum cleaner with non-metallic nozzle
3. Screwdrivers - normal duty (6-inch) and heavy duty (10-inch)
4. Crowfoot wrenches, 3/8- and 7/16-inch
5. Fuse extractor
6. Stiff-bristle brush
7. Wooden scraper
8. Long-handled paint brush (1/4-inch)
9. Plastic scale (6-inch)
10. Soldering iron
11. Needle-nose pliers
12. Fine contact file

Materials

1. Safety tags
2. Dry, lint-free rags
3. Suitable approved solvent
4. Medium sandpaper
5. Gray enamel touch-up paint, MIL-E-15090, Class 2
6. Machine oil
7. Grease, DOD-G-24508 (Mobil Grease 28)
8. Electrical tape (good grade)
9. Solder

Test Equipment

1. Multimeter, AN/PSM-4 or equivalent
2. Insulation test set, AN/PSM-2 or equivalent
3. Light or bell set

4-5. CONTROLLER MAINTENANCE

Ensure that inspection will not interfere with required online operation of equipment. Remove power as follows:

1. Deenergize incoming sources of power, including remote control, and tag OUT OF SERVICE.
2. Test equipment using multimeter to ensure that power is off.

4-5.1. Enclosure Exterior

Clean and inspect the panel exterior as follows:

1. Wipe off all dust, moisture, and oil, and remove corrosion with sandpaper.
2. Remove heavy dust or grease with a wooden scraper.
3. Remove dents.
4. Touch up all bare spots with primer and paint.
5. Inspect door gaskets for wear and/or deterioration, and replace if necessary.
6. Oil door hinges and latches with machine oil.

4-5.2. Enclosure Interior

Clean and inspect the panel interior as follows:

1. Using a vacuum cleaner with a non-metallic nozzle, remove dust and dirt from electrical components.
2. Remove sticky dust, grease, and oil using a dry rag or long-handled paintbrush (1/4-inch) damp-

ened with an approved solvent. Do not soak parts such as coils or insulation, but use just enough to loosen grease so that it can be wiped off. Ensure that contact-making and magnet face surfaces are free from dirt particles, as dirt can interfere with satisfactory operation.

3. Inspect metal parts for corrosion. Repair or replace if necessary.

4. Inspect for worn or broken parts. Repair or replace if necessary.

5. Inspect for evidence of dripping water or liquids falling on equipment parts. If found, determine the cause and correct it.

6. Ensure that all moving parts move freely and do not stick. Lubricate as necessary.

4-5.3. Wiring and Connections

Check wiring and connections as follows:

1. Inspect wiring for wear, fraying, chipping, nicks, and evidence of overheating. Repair minor defects with a good grade of electrical tape, or replace if necessary.

2. Inspect for loose electrical and mechanical connections. Tighten or replace defective crimp-style lugs. Resolder loose solder connections. Tighten or replace all loose or missing hardware.

4-5.4. Lights and Fuses

Check all indicating lights for burned out lamps. Replace as necessary.

Check all fuses for correct ratings. Replace with correct fuse as necessary.

4-5.5. Contactors

Check all contactors as follows:

1. Operate each contactor by hand to ensure that linkages operate freely from mechanical binding in the normal operating position. When released from the energized position, the contactor must drop out to the full deenergized position.To determine these positions, energize the contactors electrically, then deenergize them and check that the contactor drops out to the full deenergized position. Sticky operation may be improved by cleaning the parts with approved solvent, then applying a light coating of grease to all bearing points.

2. Inspect the ac magnet structures for dirty or rusted mating surfaces, uneven wear or pitting of mating surfaces, broken or missing pole shaders, or loose laminations from damaged or sheared rivets. An abnormally noisy contactor often exhibits these conditions.

3. Inspect the coil for signs of overheating, as indicated by discoloration of the normally green coil.

4. Examine the auxiliary contacts for evidence of excessive burning and pitting. If necessary, replace them.

5. Examine the alignment of the auxiliary contacts (see Figure 4-1). Check the alignment of any IC5181 contactors, and of any IC5182 ac relays. If required, adjust as follows:

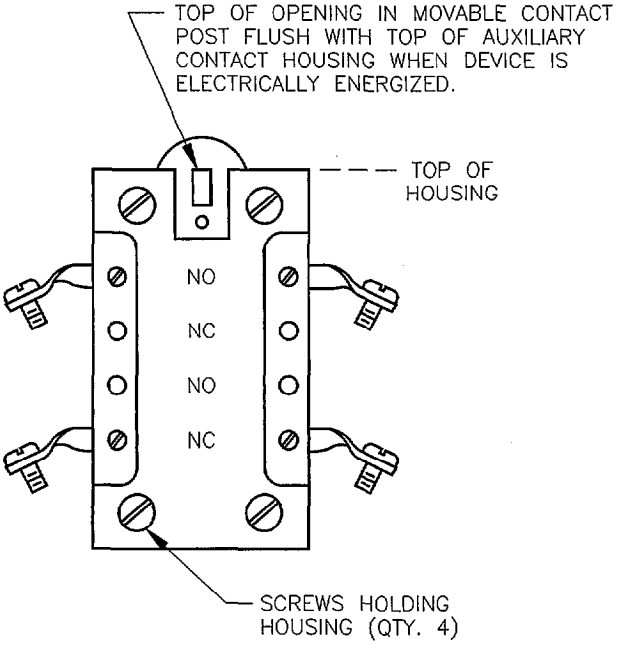


Figure 4-1. Auxiliary Contact Alignment, IC5181 Contactors

a. Loosen four screws holding the housing.

b. Realign the housing.

c. Retighten the four screws.

6. Examine the main contacts for signs of excessive burning or pitting. Replace if necessary.

7. Check contacts for wear as described below.

4-5.5.1. CONTACT WEAR. Contact wipe, or wear allowance, is the amount the movable contact support travels after the contacts touch. For an IC5181C104 contactor, the contact wipe should be maintained at .100 ±.015 inch; for an IC 5181C105, the contact wipe should be maintained at .190 ±.015 inch. Measure the wipe of the main contacts as follows (see Figures 6-4 and 6-5):

1. Remove the contactor top (8) by removing the two screws (9).

2. Connect a light or bell set across a set of stationary contacts (11).

3. Move the magnet towards the closed position until the tips just touch (indicated by the light or bell set), then measure the position of the movable contact carrier (14) with reference to a fixed point on the contactor.

4. Move the magnet to the fully closed position, then measure the position of the movable contact carrier as in step 3.

5. Subtract the first value (step 3) from the second value (step 4) to determine the contact wipe.

6. If contact wipe is out of range, adjust as follows:

   a. Loosen the two screws (one on each side of the return spring) that hold the movable contact carrier.

   b. Move the movable contact carrier up or down to the correct contact wipe.

   c. Check that all tips have the same contact wipe within ±.015 inch.

   d. Tighten the two screws and replace the top.

   e. Check for freedom of operation.

4-5.6. Insulation Resistance Test

CAUTION

Short out all meter terminals and disconnect diodes and other electronic components that might be damaged by application of insulation resistance measuring voltage before performing the insulation resistance test.

Perform an insulation resistance check between each circuit and all other grounded circuits and metal parts. Insulation resistance should equal or exceed 10 megohms. If less, isolate the areas where insulation is defective, and correct as required.

4-5.7. Online Check

Apply power to the controller and operate it. Check for proper functioning of any timing devices and for proper sequencing of all other devices.

4-6. PLANNED OVERHAUL MAINTENANCE

The preceding preventive maintenance procedures should eliminate the need for planned overhaul maintenance. Under normal service conditions, many of the components should not need replacement parts during the lifetime of the ship.

CHAPTER 5

TROUBLESHOOTING

5-1. INTRODUCTION

This chapter contains instructions to locate and correct problems in the ac controller. (Chapter 6 provides corrective maintenance procedures.) Before troubleshooting the equipment, personnel should be thoroughly familiar with chapters 1 through 3 of this manual. All warning and caution statements in the text and on the controller must be strictly followed.

5-2. REQUIRED TOOLS AND TEST EQUIPMENT

Table 5-1 lists the tools and test equipment needed for the troubleshooting procedures in this chapter.

Table 5-1. Required Troubleshooting Tools, Materials, and Test Equipment

Tools

1. Flashlight
2. Vacuum cleaner with non-metallic nozzle
3. Screwdrivers - normal duty (6-inch) and heavy duty (10-inch)
4. Crowfoot wrenches, 3/8- and 7/16-inch
5. Fuse extractor
6. Stiff-bristle brush
7. Wooden scraper
8. Plastic scale (6-inch)
9. Torque wrench, 600 inch-pounds
10. Needle-nose pliers

Materials

1. Safety tags
2. Dry, lint-free rags
3. Suitable approved solvent
4. Medium sandpaper
5. Gray enamel touch-up paint, MIL-E-15090, Class 2
6. Grease, DOD-G-24508 (Mobil Grease 28)

Test Equipment

1. Multimeter, AN/PSM-4 or equivalent
2. Insulation test set, AN/PSM-2 or equivalent

5-3. TROUBLESHOOTING PROCEDURES

WARNING

Before any maintenance, adjustments, servicing, parts replacements, or other act is performed requiring physical contact with the electrical working components or wiring of this equipment, disconnect all power supplies, then discharge and ground the equipment.

A controller malfunction is usually caused by either a ground or a short, a component failure, or an operator error. The nature of the failure usually indicates the cause. When troubleshooting a controller malfunction, first rule out or correct operator error as the cause. If operation is correct, measure incoming power to determine if the problem is in the power supply or the controller. If the input power is correct, observe the failure, measure outgoing voltages, conduct pickup and dropout checks of relays and contactors, and use other such troubleshooting techniques to isolate the problem. The following paragraphs and tables provide specific troubleshooting guidelines.

Table 5-2 is a trouble analysis chart for the controller. Refer to the controller schematic diagram, Figure 5-1.

Table 5-2. Controller Trouble Analysis Chart

Symptoms	Possible Cause	Remedy
CONTROLLER		
Fails to start	No voltage input	Check incoming power supply and turn on upstream circuit breaker or switch.
	Overload condition	Clear overload condition and reset relay.
	Contactor coil burned out	Replace contactor coil.
CONTACTS		
Chatter	Poor contact in control	Check contact wipe. Adjust if needed. Replace worn contacts.
	Low voltage	Correct voltage source.
	Accumulated dirt or grease	Clean with dry rag.
	Misalignment	Adjust.
Overheating	Insufficient contact pressure	Adjust contact wipe. Replace contacts if worn.
	Overload	Reduce load current.
Short life	Excessive filing or dressing	Replace contact(s). File only to remove projections above main contact surface.
	Overload	Reduce load current.
	Excessive jogging	Reduce jogging frequency.
	Loose connections	Tighten connections.
	Oxidation	Clean or replace contact(s).
COILS		
Open circuit	Mechanical damage	Replace coil.
Overheated coil	Wrong coil	Check coil ratings. Replace with correct coil.
	Excessive jogging	Reduce jogging frequency.
	Overvoltage source	Correct voltage source.
	Improper frequency	Correct frequency.
MAGNETS, MECHANICAL PARTS		
Wrong or broken part	Heavy slamming caused by:	
	Overvoltage	Correct voltage source.
	Wrong coil	Replace with correct coil.
	Chattering caused by broken pole shader or excessive jogging	Replace part and correct cause of damage.

Table 5-2. Controller Trouble Analysis Chart - Continued

Symptoms	Possible Cause	Remedy
Noisy Magnet	Broken pole shader, or magnet faces not true as a result of wear or mounting strains	Adjust or replace.
	Dirty magnet faces	Clean magnet faces.
Failure to pick up	Low voltage on coil	Correct voltage source.
	Open wiring of coil or shorted turns	Replace coil.
	Wrong coil	Check coil ratings. Replace with correct coil.
	Open fuse or circuit breaker	Check fuses and circuit breakers. Determine cause of open device.
	Open overload relay	Check overload relay contacts.
	Open connection	Check control circuit wiring.
WIRING		
Insulation failure	Overvoltage, voltage transition, or high induced voltages	Correct system voltage.
	Abrasion	Replace wire and relocate to avoid further abrasion.
GROUNDS	Defective wiring insulation	Replace wiring as necessary to remove grounds.
	Defective component	Replace component.
THERMAL OVERLOAD RELAYS		
Overload relay tripped	Excessive line current	Clear fault, reset overload relay. Check for correct heater (see Table 7-3). Check for motor temperature and mechanical condition.
	Low calibration trip point for application	Change heaters or adjust to increase current required to trip relay.
ROTARY TYPE RELAYS		
Any malfunction	Mechanical damage, excessive operations, overvoltage, short circuit currents	Replace relay and correct cause of failure.
CIRCUIT BREAKERS		
Instantaneous or thermal trip operated	Overloaded circuit	Correct cause of overload. Reset by turning handle to OFF, then ON.
	Misadjusted trip	Adjust.
Fuse blown	High fault current	Check for short circuits. Replace fuse. Reset circuit breaker.

Table 5-2. Controller Trouble Analysis Chart - Continued

Symptoms	Possible Cause	Remedy
INDICATING LAMPS		
Dim or out	Wrong lamp(s) installed	Check lamp type. Replace with correct lamp.
	Lamp(s) burned out	Replace lamp(s).
TRANSFORMER		
Overheating	Overcurrent or overvoltage condition	Check transformer source and load.
	Intermittent-rated unit operates continuously	Malfunction of other (external) devices. Fix device.
	Shorted turns	Replace transformer.
INDICATING FUSE HOLDERS		
Fuse blown	Overcurrent	Check for short circuits.
Fuse indicating light on		Replace fuse.

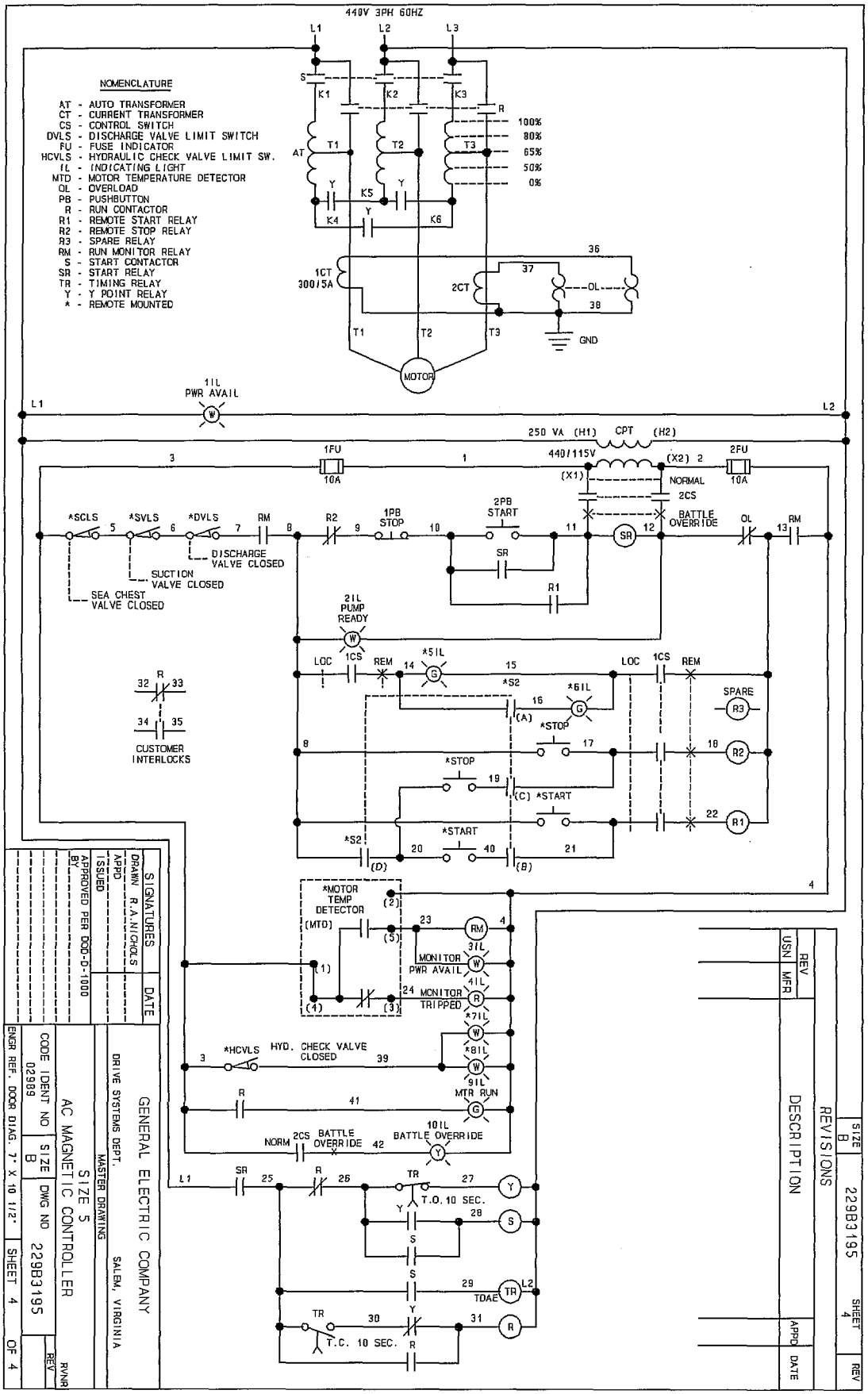


Figure 5-1. Controller Schematic Diagram (Part Number 229B3195G1S2)

CHAPTER 6

CORRECTIVE MAINTENANCE

6-1. INTRODUCTION

Corrective maintenance is required when parts need adjustment, alignment, repair, or replacement to correct equipment problems. This chapter contains corrective maintenance procedures for the controller unit. Under normal service conditions, many of the components will not require repair or replacement.

WARNING

Disconnect all power supplies before performing any maintenance, adjustments, servicing, parts replacements, or other act requiring physical contact with the electrical working components or wiring of this equipment.

Section I. ADJUSTMENTS AND ALIGNMENTS

6-2. RELAY TRIP ADJUSTMENTS

The paragraphs below provide procedures for adjusting the trip of the controller's timing and thermal overload relays. Do not alter the factory setting unless corrective action is required.

If a relay does not trip when it should, it needs a slightly lower setting; if it trips without cause, it needs a slightly higher setting.

CAUTION

Do not under any circumstances manually trip a relay by forcing the trip mechanism. This will deform the mechanism, permanently disturbing calibration.

6-2.1. Timing Relay (Agastat Type)

The dial head of the Agastat timing relay (see Figure 6-1) is marked with the time delay setting in seconds. To change the time delay:

1. Remove the tamperproof cover at the top of the relay to gain access to the dial head.

2. Slowly turn the adjusting screw clockwise to increase the time delay, or counterclockwise to decrease it (as indicated by the INCREASE or DECREASE arrows on the timing head).

CAUTION

To avoid damaging the timing relay needle or orifice, turn the adjusting screw only a fraction of a revolution before each timing check.

3. Operate the timing relay again.

4. If the time setting is still not correct, repeat steps 1 through 3 until the proper adjustment is found. DO NOT ADJUST TIME SETTING HIGHER OR LOWER THAN IS NEEDED.

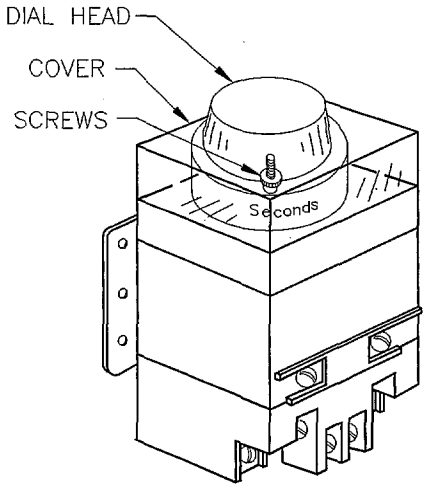


Figure 6-1. Agastat Timing Relay

6-2.2. IC5882 Thermal Overload Relay

The IC5882 thermal overload relay (see Figure 6-2) contains a permanent and an auxiliary adjustment. The permanent adjustment should not be changed from the factory setting. The auxiliary adjustment is factory set at 100%. It allows a trip setting of 90% to 110% of the factory setting. This range is shown on the relay, with the adjustment pointing at the selected setting.

To change the auxiliary adjustment:

1. Remove the relay's front cover by removing the four screws that hold it in place.
2. Inside the relay, loosen the lock screw that holds the auxiliary adjustment in place.
3. Move the auxiliary adjustment slightly (about 5%).
4. Operate the controller again.
5. If the trip is still not correct, repeat steps 3 and 4 until the auxiliary adjustment is correct. DO NOT ADJUST HIGHER OR LOWER THAN IS NEEDED.
6. When the correct setting is reached, tighten the lock screw, then replace the front cover.

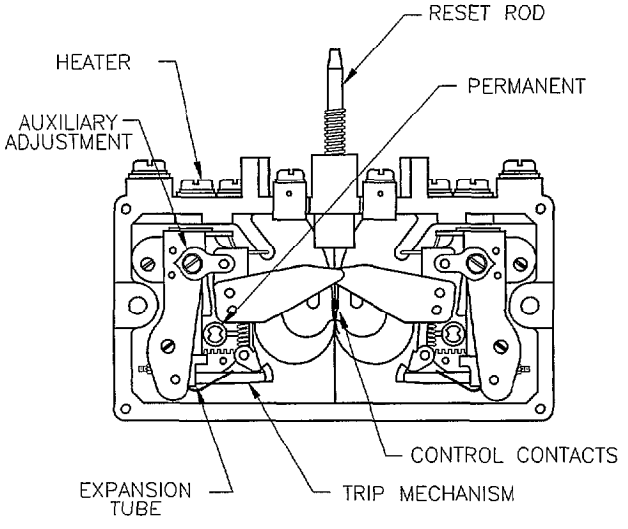


Figure 6-2. IC5882 Thermal Overload Relay

Section II. REPAIR

6-3. CONTROLLER REPAIR AND REPLACEMENT PROCEDURES

The following paragraphs identify the type and extent of corrective maintenance for the controller.

6-3.1. IC5181 Contactors

The controller contains two IC5181C105 (size 5) and one IC5181C104 (size 4) contactors. The coils, return springs, contact assembly tips, and auxiliary contact tips used in these contactors may require repair or replacement. The following paragraphs provide procedures for the replacement of these items.

6-3.1.1. COIL REPLACEMENT, IC5181C105 CONTACTOR. Replace the coil of an IC5181C105 contactor as follows (see Figures 6-3 and 6-4):

1. Remove the wiring to the coil.
2. Remove the screw (1) that holds the key (2) in place. Remove the key.
3. Mark the right end of both the armature (3) and the stationary magnet so they can be replaced in the correct position. Remove the armature.
4. Remove the four screws (5) that hold the coil and remove the coil.
5. Although the stationary magnet can now be removed, there is no need to do so. Insert the new coil and replace the four screws (5) to hold the coil in place.
6. Replace the armature (3) on the armature post (6).
7. Slide the key (2) through the armature (3) and armature post (6) as far as the projection on the key will permit.
8. Replace the screw (1), ensuring that the shoulder on the screw is bottomed against the top of the armature post and not the armature. After tightening the screw (1), ensure that the armature is free to move slightly in all directions. This enables the armature to float to find its own seat, assuring quiet operation.

9. Check the contactor operation to ensure that it works freely.

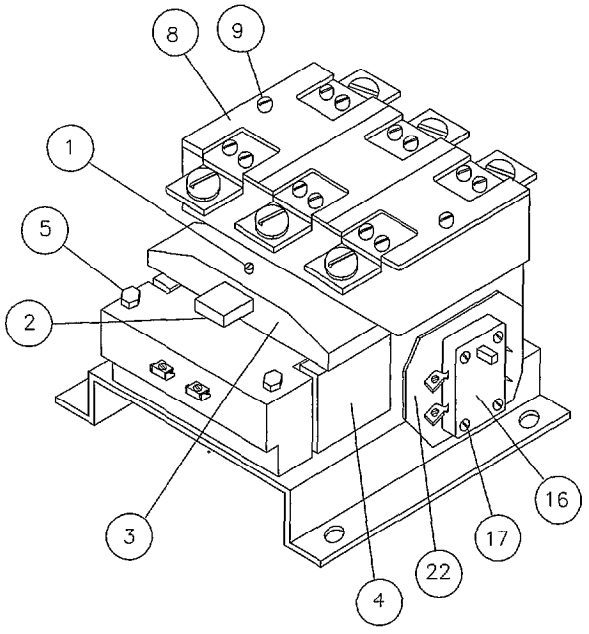
6-3.1.2. COIL REPLACEMENT, IC5181C104 CONTACTOR. Replace the coil of an IC5181C104 contactor as follows (see Figures 6-5 and 6-6):

1. Remove the wiring to the coil.

2. Remove the screw (1) that holds the key (2) in place. Remove the key.

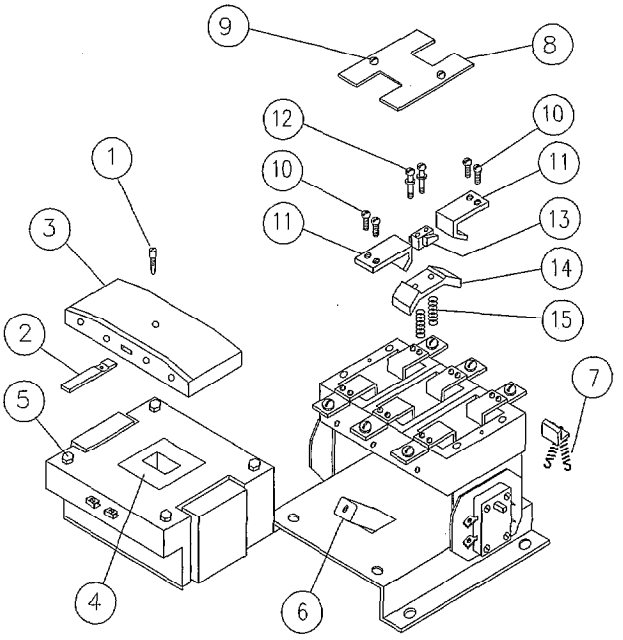
3. Mark the right end of both the armature (3) and the stationary magnet so they can be replaced in the correct position. Remove the armature.

4. Remove the two screws (4) that hold the stationary magnet assembly and remove the stationary magnet assembly.



1 Screw holding in key
2 Key
3 Armature
4 Stationary magnet
5 Screws holding coil
8 Contactor cover
9 Screws holding down cover
16 Auxiliary contact unit
17 Screw holding down auxiliary contact unit
22 Insulation piece

Figure 6-3. IC5181C105 Contactor



1 Screw holding in key
2 Key
3 Armature
4 Stationary magnet
5 Screws holding coil
6 Armature post
7 Return spring
8 Contactor cover
9 Screws holding down cover
10 Screws holding down stationary contact unit
11 Stationary contacts
12 Screws holding down plastic clamp
13 Plastic clamp
14 Movable contact
15 Contact spring

Figure 6-4. IC5181C105 Contactor, Exploded View

5. Remove the four screws (5) that hold the coil (23) and remove the coil.

6. Insert the new coil (23) and replace the four screws (5) to hold the coil in place.

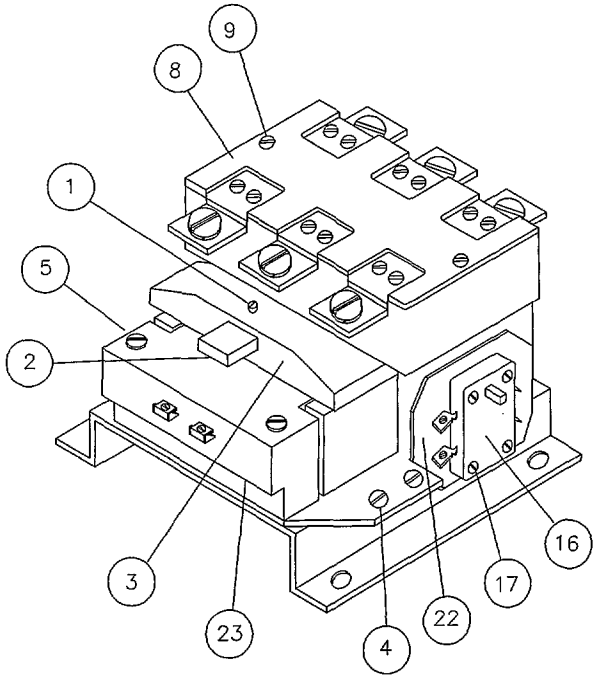
7. Replace the stationary magnet assembly by sliding it over the armature post (6). This assembly is positioned by two projections on its bottom that fit into two holes in the base. Replace the two screws (4) that hold the stationary magnet assembly in place.

8. Replace the armature (3) on the armature post.

9. Slide the key (2) through the armature (3) and armature post (6) as far as the projection on the key will permit.

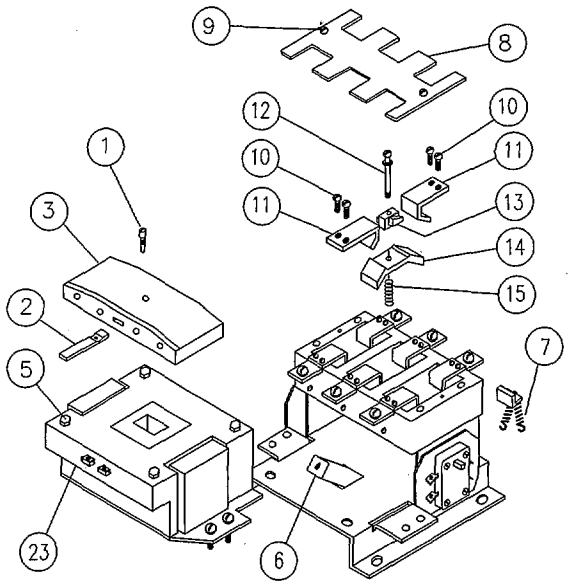
10. Replace the screw (1), ensuring that the shoulder on the screw is bottomed against the top of the armature post and not the armature. After tightening the screw (1), ensure that the armature is free to move slightly in all directions. This enables the armature to float to find its own seat, assuring quiet operation.

11. Check the contactor operation to ensure that it works freely.



1 Screw holding in key
2 Key
3 Armature
4 Screw holding stationary magnet assembly
5 Screws holding coil
8 Contactor cover
9 Screws holding down cover
16 Auxiliary contact unit
17 Screw holding down auxiliary contact unit
22 Insulation piece
23 Coil

Figure 6-5. IC5181C104 Contactor



1 Screw holding in key
2 Key
3 Armature
5 Screws holding coil
6 Armature post
7 Return spring
8 Contactor cover
9 Screws holding down cover
10 Screws holding down stationary contact unit
11 Stationary contacts
12 Screws holding down plastic clamp
13 Plastic clamp
14 Movable contact
15 Contact spring
23 Coil

Figure 6-6. IC5181C104 Contactor, Exploded View

6-3.1.3. RETURN SPRING REPLACEMENT. Replace a return spring (7) of either of the IC5181 contactors as follows (refer to Figure 6-4 or 6-6):

1. Using needle nose pliers, unhook each end of the spring and remove the spring.

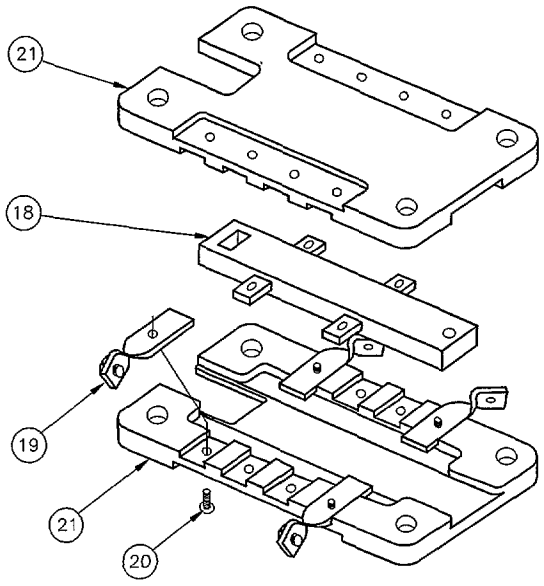
2. Hook the new spring in the same position.

6-3.1.4. CONTACT ASSEMBLY. The contact assembly of the IC5181 contactor contains the movable and stationary contact tips and the contact spring. Replace one or all of the parts as follows (refer to Figure 6-4 or 6-6):

1. Remove the screws (9) that hold the cover (8) in place and remove the cover.
2. Remove the screws (10) that hold the stationary contacts (11) in place and remove the stationary contacts.
3. Loosen the screw (12) that holds the plastic clamp (13) in place.
4. Grasp the plastic clamp (13) between thumb and forefinger and remove it. The screw (12), clamp (13), movable contact (14), and contact spring (15) will be removed as a unit.
5. Assemble the new contact and spring, as shown in the figure. Ensure that the movable contact's silver alloy faces are assembled toward the clamp (13), and that the clamp is aligned so that the projections on the movable tip carrier mate with the slots on the sides of the clamp.
6. Slide the assembly into place (do not force it) and tighten the screw (12).
7. Check that the contact assembly operates freely by pressing both sides of the movable contact (14) simultaneously.
8. Position the new stationary contact tip (11) and fasten it in place with the screw (10).
9. Check that the silver alloy faces of the movable contact meet those of the stationary contact when the contact closes. If not, the movable contact may have been assembled upside down. Repeat steps 3 through 5, ensuring that the movable contact is repositioned so that the silver alloy contact faces meet properly when installed.
10. Check for proper contact wipe (refer to paragraph 4-5.5.1) and freedom of operation.
11. Replace the cover (8) and fasten it in place with screws (9).

6-3.1.5. AUXILIARY CONTACTS. Replace the auxiliary contacts as follows (refer to Figure 6-3 or 6-5 and Figure 6-7):

1. Remove the auxiliary contact unit (16) by removing the four screws (17).
2. Separate the unit housing into its two identical halves (21).
3. Replace the internal movable contact (18) as a unit.
4. Replace the internal stationary contacts (19) by removing the screws (20).
5. Reassemble the two halves of the unit housing (21) so that the rectangular opening in the internal movable contact (18) and the slots in the housing halves are at the top of the assembly. Ensure that the insulation piece (22) is in place.
6. Attach the auxiliary contact unit (16) to the contactor using the four screws (17). Align contact housing per Figure 4-1.
7. Check for freedom of operation.



18 Internal movable contact
19 Internal stationary contact
20 Screw holding in stationary contact
21 Auxiliary contact unit housing

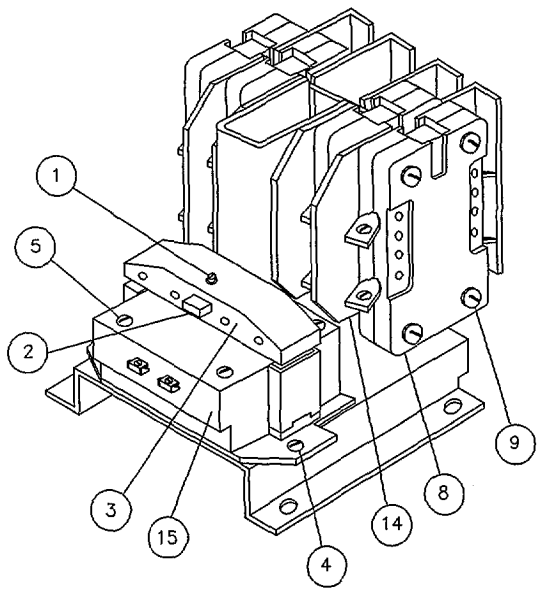
Figure 6-7. Contactor Auxiliary Contacts, Exploded View

6-3.2. IC5182 Multipole Relay

The coils, return springs, and contacts used in the IC5182 multipole relay may require repair or replacement. The following paragraphs provide procedures for the replacement of these items.

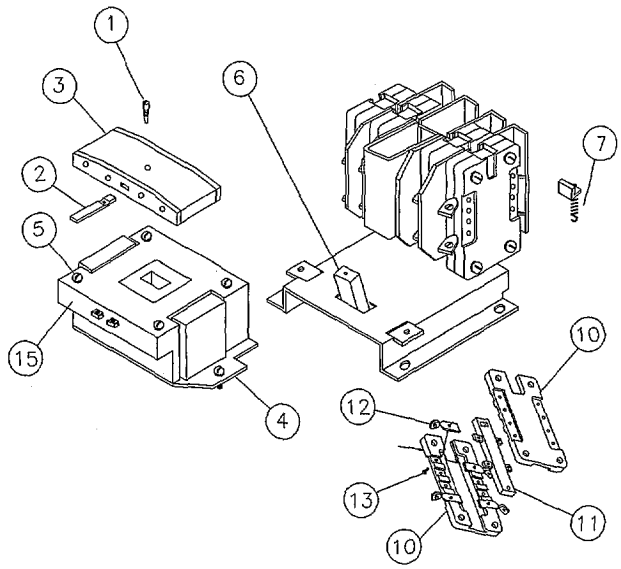
6-3.2.1. COIL REPLACEMENT. Replace a relay coil as follows (refer to Figures 6-8 and 6-9):

1. Remove the wiring to the coil.
2. Remove the screw (1) that holds the key (2) in place. Remove the key.
3. Mark the right end of both the armature (3) and the stationary magnet so they can be replaced in the correct position. Remove the armature.
4. Remove the two screws (4) that hold the stationary magnet assembly and remove the stationary magnet assembly.



1 Screw holding in key
2 Key
3 Armature
4 Screw holding stationary magnet assembly
5 Screws holding coil
8 Contact unit
9 Screw holding contact unit
14 Insulation piece
15 Coil

Figure 6-8. IC5182 Multipole Relay



1 Screw holding in key
2 Key
3 Armature
5 Screws holding post
6 Armature post
7 Return spring
10 Contact unit housing
11 Movable contact assembly
12 Stationary contact
13 Screw holding in stationary tip
15 Coil

Figure 6-9. IC5182 Multipole Relay, Exploded View

5. Remove the four screws (5) that hold the coil (23) and remove the coil.
6. Insert the new coil (15) and replace the four screws (5) to hold the coil in place.
7. Replace the stationary magnet assembly by sliding it over the armature post (6). This assembly is positioned by two projections on its bottom that fit into two holes in the base. Replace the two screws (4) that hold the stationary magnet assembly in place.
8. Replace the armature (3) on the armature post (6).
9. Slide the key (2) through the armature (3) and armature post (6) as far as the projection on the key will permit.

10. Replace the screw (1), ensuring that the shoulder on the screw is bottomed against the top of the armature post and not the armature. After tightening the screw (1), ensure that the armature is free to move slightly in all directions. This enables the armature to float to find its own seat, assuring quiet operation.

11. Check the contactor operation to ensure that it works freely.

6-3.2.2. RETURN SPRING REPLACEMENT. Replace a return spring (7) of the IC5182 multipole relay as follows (refer to Figure 6-9):

1. Using needle nose pliers, unhook each end of the spring and remove the spring.

2. Hook the new spring into the same position.

6-3.2.3. AUXILIARY CONTACTS. Replace the auxiliary contacts of the IC5182 multipole relay as follows (refer to Figures 6-8 and 6-9):

1. Remove the contact unit (8) by removing the four screws (9).

2. Separate the unit housing into its two identical halves (10).

3. Replace the movable contact assembly (11) as a unit.

4. Replace the stationary contacts (12) by removing the screws (13).

NOTE

To change the relay contacts from normally open to normally closed, move the set of stationary contacts to the positions indicated by the marking on the outside of the contact unit housing.

5. Reassemble the two halves of the unit housing (10) so that the rectangular opening in the movable contact assembly (11) and the slots in the housing halves are at the top of the assembly. Ensure that the insulation piece (14) is in place.

6. Attach the contact unit (8) to the contactor using the four screws (9).

7. Check for freedom of operation.

8. Check that the contact unit is set properly. To be correct, the top of the opening in the movable contact must be flush with the top of the contact housing when the device is electrically energized (refer to Figure 4-1).

6-3.3. Fuse Replacement

The fuses for the controller are housed in indicating fuseholders located on the front panel. This enables the operator to replace fuses without entering the controller. The fuseholders hold the fuses at both ends. Replace a fuse as follows:

1. Remove the front cover of the fuseholder by unscrewing the knob on the cover, then removing the cover.

2. Remove the fuse.

3. Use an ohmmeter to test for an open fuse.

4. If the fuse is open, correct the cause, then insert a new fuse. If the fuse is not open, reinsert the old fuse.

6-3.4. Indicator Light Replacement

Indicator lights used in the controller use two T-1 3/4 midget screw-base lamps connected in parallel (see Figure 6-10). To replace a burned out or faulty lamp, remove the lens cap, replace the lamp, and replace the lens cap.

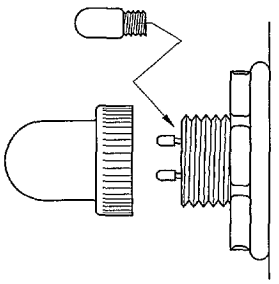


Figure 6-10. Indicator Light Assembly

6-3.5. Pushbutton Replacement

There is no recommended maintenance for the pushbuttons used in the controller. A pushbutton should be replaced as a unit as follows:

1. Remove the pushbutton assembly from the controller door by removing the two screws that hold the pushbutton assembly and nameplate in place. Remove the nameplate and pull the switch from the controller door.
2. Tag all wires so that they can be reconnected correctly, then disconnect the wires from the pushbutton assembly.
3. Connect the wires as tagged to the new pushbutton assembly.
4. Insert the new pushbutton into the controller door and place the nameplate into position. Mount the pushbutton and nameplate using the two screws.

6-3.6. Relay, Switch, and Transformer Replacement

There is no recommended maintenance for the timing relay (Agastat), control switches, control power transformer, or current transformers used in the controller. These devices should be replaced using the following general procedure (see transformer Tables 6-1 and 6-2):

1. Dismount the device by removing the screws that hold it in place.
2. Tag all wires so that they can be reconnected correctly, then disconnect the wires from the device.
3. Connect the wires as tagged to the new device.
4. Mount the new device and secure it with the mounting screws.

Table 6-1. Autotransformer Data

Part Number	Percentage of Tap	Number of Turns Between Taps	Condition in Parallel
Transformer 3323806	0 - 50	30	2
	50 - 65	14 and 5	2 and 4
	65 - 80	5 and 3	4 and 6
	80 - 100	6 and 6	6 and 6

Table 6-2. Current Transformer Data

Part Number	Current	Wire Size	Ratio
Transformer 750X12G7	300 A	3/0	60/1
	5 A	15	60/1

CHAPTER 7

PARTS LIST

7-1. INTRODUCTION

This chapter identifies the major components of the GE IC5130B38 ac motor controller. The list enables the user to identify and order replaceable parts. Table 7-1 lists the controller replacement parts. Figure 7-1 shows the controller with the parts identified.

7-2. USING THE PARTS LIST

In Table 7-1, the Figure and Item Number column references the drawing and the item number in that drawing for each part. The FSCM column identifies the Federal Supply Code identification number for the manufacturer of each part. The other columns describe the part, list the number of parts per controller, and identify the manufacturer's part number for ordering that part. To use the table for replacing a part:

1. Identify the item to be replaced by the manufacturer's part number on its nameplate (unless the nameplate has been damaged or lost).

2. If the item nameplate is intact, identify the part by matching the manufacturer's part number in the table with the number listed on the item nameplate. Go to step 5. If there is no readable nameplate, use Table 7-1 to find the figure that identifies the part, and refer to that figure.

3. In the figure, locate the item to be replaced and note the identification number for that item in the figure. Refer back to Table 7-1.

4. Under the parts listing for the controller, match the item number in the figure with that listed in the table. Go to the column that lists the manufacturer's part number for that item.

5. Find the FSCM number for the manufacturer. Refer to Table 7-2, which identifies the manufacturer by the FSCM number and gives the manufacturer's address.

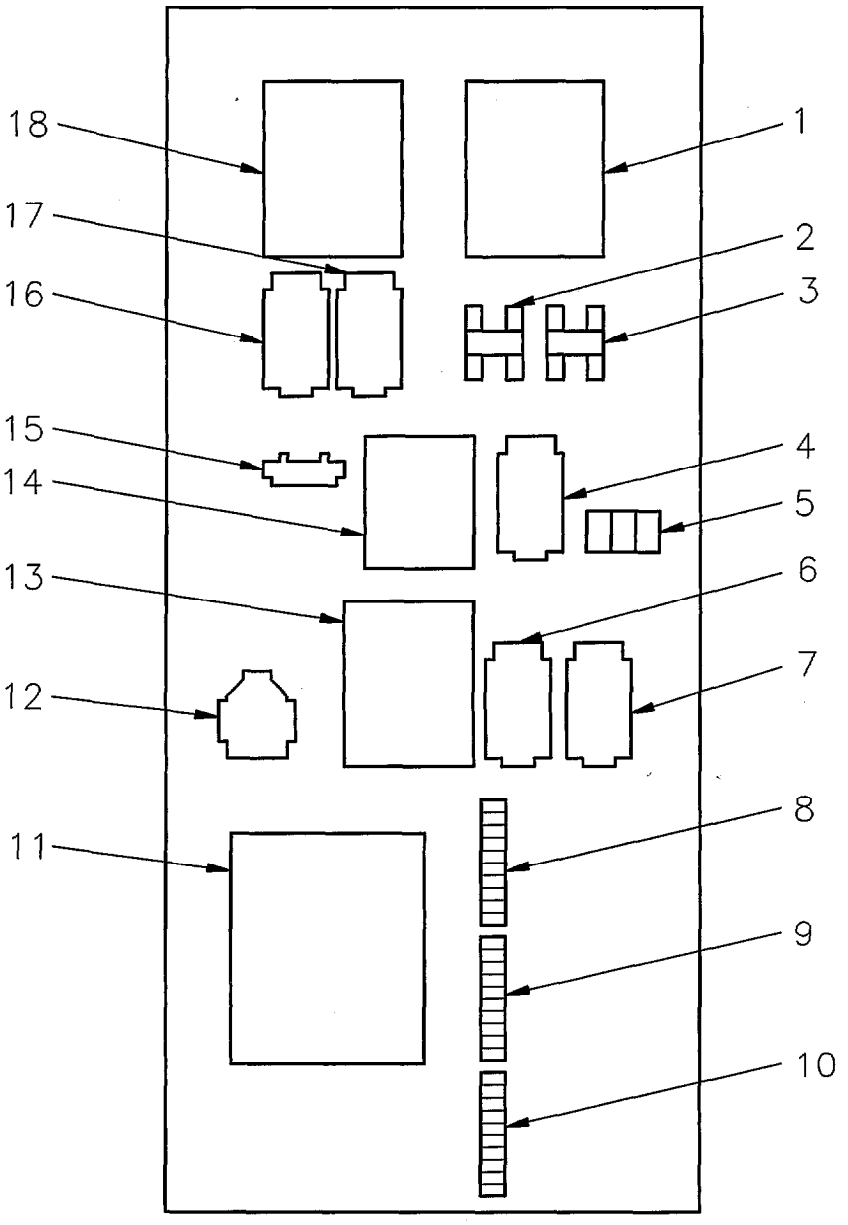
6. Contact the manufacturer and order the number of parts needed, using the manufacturer's part number and the description of the part.

Table 7-1. Parts List

Figure and Item Number	Name of Part	Quantity Per Set	Manufacturer's Part Number	FSCM
7-1, 13	Contactor (Y)	1	IC5181C104A6XAXX	02989
6-6, 23	Coil	1	174A7667G6	02989
6-6, 14	Movable contact	3	174A5315G1	02989
6-6, 11	Stationary contact	6	174A5316G1	02989
6-6, 15	Contact spring	3	174A7635P1	02989
6-6, 7	Return spring	1	174A7633P1	02989
6-7, 18	Internal movable contact	1	129B6882G1	02989
6-7, 19	Internal stationary contact	4	174A7137P1	02989
7-1, 18	Contactor (S)	1	IC5181C105A6XABA	02989
6-4, ---	Coil	1	193A9636G6	02989

Table 7-1. Parts List - Continued

Figure and Item Number	Name of Part	Quantity Per Set	Manufacturer's Part Number	FSCM
6-4, 14	Movable contact	6	188A4581G1	02989
6-4, 11	Stationary contact	12	188A4583G1	02989
6-4, 15	Contact spring	6	193A9473P1	02989
6-4, 7	Return spring	2	193A9474P1	02989
6-7, 18	Internal movable contact	6	129B6882G1	02989
6-7, 19	Internal stationary contact	24	174A7137P1	02989
7-1, 1	Contactor (R)	1	IC5181C105A6XABA	02989
6-4, ---	Coil	1	193A9636G6	02989
6-4, 14	Movable contact	6	188A4581G1	02989
6-4, 11	Stationary contact	12	188A4583G1	02989
6-4, 15	Contact spring	6	193A9473P1	02989
6-4, 7	Return spring	2	193A9474P1	02989
6-7, 18	Internal movable contact	6	129B6882G1	02989
6-7, 19	Internal stationary contact	24	174A7137P1	02989
7-1, 17, 6, 4, 16, 7	Relay (R1 - R3, SR, RM)	5	IC5182C120A3AAAA	02989
6-9, 15	Coil	5 (1 per relay)	174A7624G3	02989
6-9, 11	Movable contact	20 (4 per relay)	129B6882G1	02989
6-9, 12	Stationary contact	50 (10 per relay)	174A7137P1	02989
6-9, 7	Return spring	5 (1 per relay)	181A5988P1	02989
7-1, 15	Overload relay (OL)	1	IC5882D121B	02989
6-2, ---	Overload heater	2	See Table 7-3	02989
2-1, 1	Fuse (1FU, 2FU)	2	F60C500V10AS	02989
6-10, ---	Indicating light (2 - 4IL, 9IL, 10IL)	5	288A896AAP1	02989
6-10, ---	Indicating light (1IL)	1	288A896AAP2	02989
6-10, ---	Lamp	12	288A896BFP3	02989
2-1, 8 & 6	Control switch (1CS, 2CS)	2	288A886XTP1	82121
2-1, 9 & 5	Pushbutton (1PB, 2PB)	2	5729215G1	02989
2-1, 7	Pushbutton (RESET)	1	188A1770G1	02989
7-1, 14	Control power transformer (CPT)	1	573A499FZP7	83325
7-1, 11	Autotransformer (AT)	1	3323806	02989
7-1, 2 & 3	Control transformer (1CT, 2CT)	2	750X12G7	02989
7-1, 12	Timing relay (TR)	1	231B244AFP23	98403



1 Contactor (R)
2 Control transformer (1CT)
3 Control transformer (2CT)
4 Relay (R3)
5 Terminal board (1TB)
6 Relay (R2)
7 Relay (RM)
8 Terminal board (2TB)
9 Terminal board (3TB)
10 Terminal board (4TB)
11 Autotransformer (AT)
12 Timing relay (TR)
13 Contactor (Y)
14 Control power transformer (CPT)
15 Overload relay (OL)
16 Relay (SR)
17 Relay (R1)
18 Contactor (S)

Figure 7-1. Controller Parts Location

Table 7-2. List of Parts Manufacturers

FSCM	Manufacturer
02989	GE Drive Systems 1501 Roanoke Boulevard Salem, VA 24153
98403	Amerace Corporation Control Products Division 1000 Hickory Street Grafton, WI 53024
82121	Electro Switch Corporation 180 King Avenue Weymouth, MA 02188
83325	SNC Manufacturing Company, Incorporated 101 Waukau Road Oshkosh, WI 54901

Table 7-3. Overload Heater Part Numbers

Heater Part Number	Continuous Motor Load - Amps	
	Minimum	Maximum
81D322	127	136
81D323	139	153
81D324	154	168
81D325	169	185
81D326	186	205
81D327	206	225
81D328	226	246
81D329	247	261
81D330	262	289

CHAPTER 8

INSTALLATION

8-1. INTRODUCTION

This chapter contains the information necessary to install the equipment. Before performing any installation work, consult the drawings in this manual.

8-2. RECEIVING AND HANDLING

General Electric carefully inspects and packs all equipment before shipping it from the factory. Upon receipt of this equipment, immediately inspect it for missing or damaged items. A packing list, included in each case of the equipment, itemizes the contents of each package of the shipment. When unpacking, check the contacts of each case against the packing list. Carefully inspect the packing material to avoid losing small parts.

If damage is evident or if there is visual indication of rough handling, immediately file a damage claim with the carrier. Then notify both the transportation company and General Electric Company.

The equipment is shipped with a 3-inch by 30-inch lifting angle (see Figure 8-1). The equipment is shipped in an upright position, which should be maintained during handling. Never attempt to jack, lift, or move the equipment at points other than the lifting angle or floor sills. The lifting angle should be removed only upon installation.

CAUTION

Before moving equipment, ensure that the doors are closed and their thumb screws are fastened.

8-2.1. Removing the Lifting Angle

The lifting angle (see Figure 8-1) is bolted through 1-inch thick washers into weld nuts on the inside top of the equipment. Lifting holes are 5/8 inches in diameter.

8-3. UNPACKING

It is good practice to not completely unpack the equipment until it has been placed as near as possible to its intended permanent location. Use standard unpacking tools, including a nail puller. Carefully remove equipment from its container to avoid damaging or marring the part.

Small parts (such as bolts and screws) are packed in special containers to keep them together, but they may become separated. For this reason, carefully inspect packing material for loose parts before discarding it. Wipe off any particles of packing material or foreign substances that may be lodged in or between the parts.

8-4. STORAGE

If the equipment is not installed immediately upon receipt, use the following storage procedures to protect it from breakage, corrosion, damage, and deterioration:

1. Unpack and label the equipment.
2. The packing coverings do not protect the equipment for outdoor storage. Place the equipment under adequate cover, with the following precaution:
   a. Keep the equipment clean and dry, and protect it from extreme temperature variations, high humidity, dust, and rodents.
   b. Use only breathable (canvas type) covering material - do not use plastic.
   c. Absolute storage temperature limits are -40 °C (-40 °F) to 70 °C (158 °F).
   d. Equipment may be stored in environments of 5-95% relative humidity with provisions to prevent condensation.
3. To prevent moisture condensation on the equipment, as caused by variations in the storage temperature, keep the equipment's internal

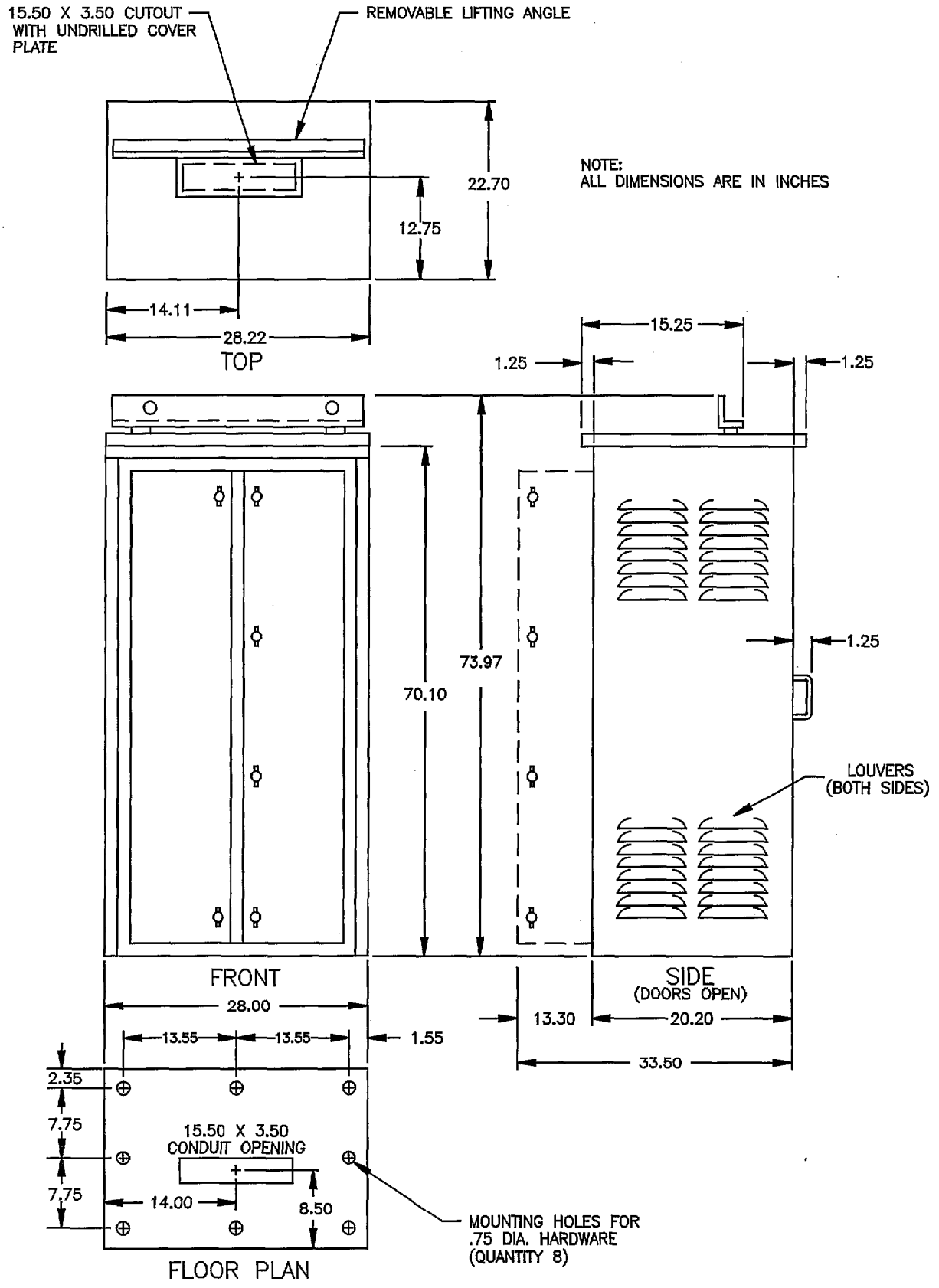


Figure 8-1. Controller Outline Drawing and Mounting Details

temperature 5-10 °C higher than the outside ambient temperature. This can be done by adding space heaters or by using panel space heaters, when supplied. (Heaters require an external ac power supply.)

CAUTION

Remove all cartons and other miscellaneous material packed inside units before energizing any heaters.

8-5. INSTALLATION

8-5.1. Preparation

Before starting any installation, consult and study all furnished drawings. These drawings should include arrangement drawings, connection diagrams, elementary diagrams, and a summary of the equipment.

8-5.2. Mounting

Each controller is to be deck mounted on a flat surface. Take care not to twist or warp the enclosure. The outline drawing for the enclosure (see Figure 8-1) specifies the number, size, and location of bolts for mounting.

The mounting dimensions allow a normal factory tolerance of $\pm 1/16$ inch. Therefore, alignment problems may occur if mounting provisions are based upon the drawing dimensions. Also note that the mounting bolt clearance holes located in the enclosures are only 1/32 inch oversize per MIL-S-901, "Shockproof Equipment, Class HI (High Impact), Shipboard Applications, Tests for."

8-5.3. Incoming Cabling and Wiring

WARNING

Before handling and connecting any power cables to the equipment, ensure that all power supplies are turned off. Then check voltage levels on the wiring to ensure that the wiring is not carrying hazardous voltages.

The required power input to the controller is 440 V ac, 3-phase, 60 Hz. Table 8-1 shows the external wiring connections to the controller.

8-6. INSPECTION AND PREENERGIZING PROCEDURES

After completing the installation, wiring, and normal circuit checks, the technician should complete the following actions before energizing the equipment:

1. Verify that each controller is installed according to the specifications described in paragraph 8-5.

2. Megger all terminals for grounds. Isolate from the circuit any control device or instrument that is sensitive to megger voltage.

Table 8-1. External Wiring Connections

Type of Input	Connections
Motor	T1 (1TB-1)
	T2 (1TB-2)
	T3 (1TB-3)
Power	L1
	L2
	L3
Terminal Board	1TB-1 (wire T1)
	1TB-2 (wire T2)
	1TB-3 (wire T3)
	2TB-1 (wire 3)
	2TB-2 (wire 4)
	2TB-3 (wire 5)
	2TB-4 (wire 6)
	2TB-5 (wire 7)
	2TB-6 (wire 8)
	2TB-7 (wire 14)
	2TB-8 (wire 15)
	2TB-9 (wire 16)
	2TB-10 (wire 17)
	3TB-1 (wire 19)
	3TB-2 (wire 20)
	3TB-3 (wire 21)
	3TB-4 (wire 23)
	3TB-5 (wire 24)
	3TB-6 (wire 32)
	3TB-7 (wire 33)
	3TB-8 (wire 34)
	3TB-9 (wire 35)
	3TB-10 (wire 39)
	4TB-1 (wire 40)

3. Operate each magnetic device by hand to ensure that all moving parts operate freely. Check all electrical interlocks for proper operation.

4. If a current transformer circuit is not complete, it is shipped with a shunt across the secondary. During installation, complete the connections to the transformer secondary, then remove the shunt.

5. Ensure that the horsepower rating and voltage of the ac motor do not exceed those stamped on the controller nameplate.

6. Check each overload heater against the full load current listed on support drawings.

7. Clean the controller interior with a dry rag or compressed air.

8. Close the controller door and turn all disconnects to OFF before energizing the controller.

8-7. TURN ON AND PRELIMINARY TESTS

1. Turn on the controller according to the instructions in Table 2-2.

2. Verify the incoming and outgoing power with the schematic diagram in Figure 5-1.

8-8. INSTALLATION VERIFICATION TEST

1. After each controller unit has passed the steps in sections 8-6 and 8-7, verify that all indicating lights are properly lit and that all controls function according to their descriptions in Table 2-1.

2. If a malfunction is detected, troubleshoot according to the instructions in Chapters 5 and 6.